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CFD-Simulation – a Rhinodiagnost Service

Angewandte Informationstechnik Forschungsgesellschaft mbH

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Objectives

Development of Services (and Products) supporting Diagnostic Activities of ENT-Experts and Using CFD-Simulations

Services:

- Upload of CT-Scans onto a PACS Server (DICOM-Format)
- Creation of 3D-Models
- CFD-Simulation
- 3D-Print Services
- Volumetric Services for Paranasal Sinuses ("Swelling") (except: ethmoid cells)

Products:

- Nasal Airflow Simulator





Service Platform



Services

Welcome to the Rhinodiagnost Service Platform

The Rhinodiagnost Service platform offers various services for uploading CT images and creating 3D Models of the nasal and paranasal cavities. Please be aware that this is a test site.

3D Mesh Visualization Service

You can upload DICOM images which are then stored on an Orthanc Server. A 3D model of the nasal cavities is produced and the various nasal cavities are separated in the model. As one first result the service delivers a visualization of the swelling of tissue within the nasal cavities.



Service: Upload of CT-Scans



- Directly over the Internet (online-service)
- Offline via a storage medium (e.g.USB-device, CD-ROM,...)
- Data can be anonymized and will be stored on the Rhinodiagnost-PACS-Server (OpenSource)

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KRZS_0074_H70h_1151.600.dcm	16.04.2018 11:37	DCM-Datei	517 KB	
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Upload CT	s		
Clonke Chigins		Lookup studies	🕞 Upload 🕐 QueryRetrieve 🛞 Jobs
ORTHANC			

Management of DICOMs (1)



Upload CTs View 3D Models Support Services **Upload CTs** Lookup Plugins Rhinodiagnost for naseweis » Patient 🙆 Upload Query/Retrieve G Jobs Patient Q Filter items... 0001 Instance: 1 PatientBirthDate: ? 1 5 Θ ImageOrientationPatient: 1\0\0\0\1\0 PatientID: 0b3b9b19-... SOPInstanceUID: 1.3.12.2.1107.5.1.4.65733.30000016100312390670400005571 PatientSex: F Study Instance: 2 Ω ImageOrientationPatient: 1\0\0\0\1\0 HEAD SOPInstanceUID: 1.3.12.2.1107.5.1.4.65733.30000016100312390670400005573 AccessionNumber: ReferringPhysicianNa... 1 5 Instance: 3 StudyDate: Wednesd ... Θ ImageOrientationPatient: 1\0\0\0\1\0 StudyID: H70h SOPInstanceUID: 1.3.12.2.1107.5.1.4.65733.30000016100312390670400005574 StudyInstanceUID: 1.3... Series Instance: 4 Θ ImageOrientationPatient: 1\0\0\0\1\0 0030 53F H70h SOPInstanceUID: 1.3.12.2.1107.5.1.4.65733.30000016100312390670400005575 Status: Unknown

Inspection of uploaded Data

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Management of DICOMs (2)



Patient	DICOM Tare
0001	DICOM Tags
PatientBirthDate: ? 1 5 PatientID: 0b3b9b19	Show tag description
PatientSex: F	0002,0003 (MediaStorageSOPInstanceUID):
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Series	0008,0050 (AccessionNumber): 0008,0060 (Modality): CT
0030 53F H70h Status: Unknown	0008,0070 (Manufacturer): SIEMENS 0008,0090 (ReferringPhysicianName): 0008,1030 (StudyDescription): HEAD
196 booyr allexamined. H	0008,103e (SeriesDescription): 0030 53F H70h

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Service: 3D-Model Creation



Entry of Parameters for the Mesh (3D-Model) Creation

3D Meshes	
9classes-191119	Parts nasal_cavities v
Working	×
Generate 3D Mesh 9 20191119_043840.8	-CLASSES-MULTI- 56297-ITER-23472
	load_volume
Working	×
Generate 3D Mesh 9 20191119_043840.8	9-CLASSES-MULTI- 356297-ITER-23472
nasal-and-oral-	cavities → create_surface_mesh

Services	Upload CTs	View 3D Models	Support	
Viev Patient:	0001 F] 2017-12-19 F ages	odels HEAD	,	
Patient Study o Body P CT Slic DEBUO Series GUID	date date e Count	Create 3 Paramete Classifier Mesh smo Reduce fac	D Mesh ers othing (Lapl ce count to	ace) 100000 Start creation Close
3D Moo	del Par	[Not yet calculated] Parts Generate new Mesh		View Delete
Swelling calculation				

3D-Model: Tools (1)







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3D-Model: Tools (2)





3D-Model: Tools (3)



Compare ROIs of different Patients (Data Base Lookup)



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Service: CFD-Simulation (1)

Air flow velocity (absolute) on certain slices through the nasal cavities. Sagittal view of 3D model displayed in ParaView. View through the right side of the nasal cavities

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Service: CFD-Simulation (2)



1.2.4 View of the air velocity along stream lines

Left side view (sagittal)



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Service: Simulation Report (1)



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Service: Simulation Report (2)



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- 2D Models are stored in the Phinodian

Service: 3D-Print

- 3D-Models are stored in the Rhinodiagnost (RD)Workspace as STL-Files
- STL-Files can be downloaded on the Personal Computer
- STL-Files can be sent to an RD-Partner for Printing





Service: Volumetric Meas.(1)



- Available for Paranasal Sinuses:
 - Maxillary Sinus
 - Frontal sinus
 - Sphenoid sinus
- The distance between the inner surface of the bone around a cavity and the surface of a cavity itself (surface of the air mesh) can yield information about pathological obstructions. Furthermore, volumes, changes in volume and differences between volumes can be computed.

Service: Volumetric Meas.(2)

Distance: red = high value blue = low value



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Service: Volumetric Meas.(3)

Increase in average distance between bone and cavity of sinus suggests pathological change.



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Product: Nasal Airflow Simulat.



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Nasal Airflow Simulator (NAS)

NAS-User Interface





In the Pipeline



Calculation of the Nasal Resistance in Segments ("Main" Nasal Cavities)



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Septum

Programme for 2021



- Continuation of MoU Arrangements
- First Half of 2021: Stepwise Introduction of Services
- MoU Partners can use all Services Free of Charge (Fair Use)
- First twenty 3D-Printed Models are Free of Charge
- In co-operation with the Medical University Vienna introductory courses for Rhinodiagnost (RD) Services will be offered (Webinars)
- An RD-Newsletter can be subscribed
- New partnerships for R&D-Projects are welcome:
 - Development of a Treatment Simulator
 - 3D-Print of personalized Instruments





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